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OPERATIONS AND MAINTENANCE MANUAL APPENDIX B

BASIN F INTERIM RESPONSE ACTION  
GROUND AND SURFACE-WATER MONITORING PROGRAM TECHNICAL PLAN

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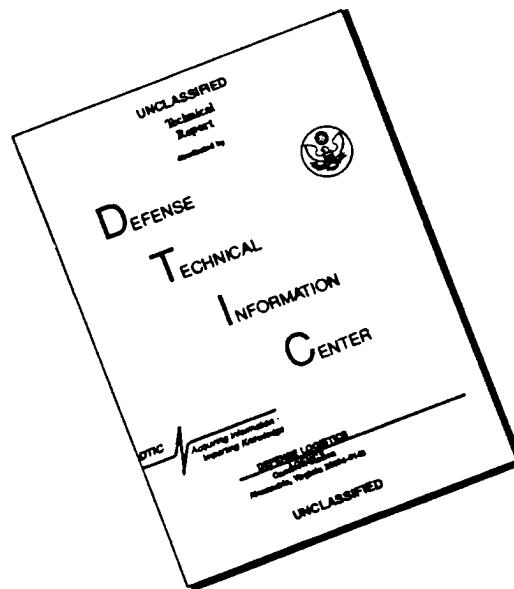
PROGRAM MANAGER FOR ROCKY MOUNTAIN ARSENAL

19960509 016

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APPENDIX B

GROUND AND SURFACE-WATER MONITORING PROGRAM  
TECHNICAL PLAN

## 1.0 INTRODUCTION

This groundwater and surface-water monitoring plan has been prepared by R.L. Stollar and Associates, Inc. (Stollar), and Harding Lawson Associates (HLA) for the Program Manager for Rocky Mountain Arsenal (PMRMA) for groundwater and surface-water monitoring activities at the Basin F Interim Response Action (IRA) area at Rocky Mountain Arsenal (RMA). The plan is a subpart of the PMRMA groundwater and surface-water elements of the Comprehensive Monitoring Program (CMP).

### 1.1 COMPREHENSIVE MONITORING PROGRAM

The purpose of the CMP is to monitor and evaluate data generated during groundwater and surface-water monitoring activities at RMA and adjacent offpost areas on a long-term basis. The groundwater element of the CMP provides both regional and site-specific monitoring and evaluation of water levels and water quality. Groundwater wells in the Basin F IRA area are monitored four times per year. The surface-water element of the CMP provides monitoring in the Basin F IRA area when sufficient quantities of surface runoff exist for sampling and/or gaging.

The Basin F IRA provided for the construction of temporary containment structures to hold the contaminated liquid, soil, settled solids, liner, and overburden from Basin F. The Basin F IRA area consists of the following structures: a 92.7-acre surface depression formerly occupied by Basin F that has been excavated and covered with a contoured low-permeability clay cap; a 16-acre double-lined, enclosed waste pile located within the historic perimeter of the basin; a double-lined waste pile leachate collection pond adjacent to the waste pile; two double-lined liquid storage ponds (Ponds A and B) immediately north of the basin; and three carbon steel holding tanks located east of the basin. These structures were installed in the Basin F IRA area during 1988 and 1989. Water monitoring activities will be performed in the Basin F IA area in an attempt to determine the effects of installation on the water table and contaminant migration.

Evaluations of the groundwater data are presented in annual CMP groundwater reports (Stollar and others, 1989, 1990a, 1991). Evaluations of the surface-water data are presented in



annual CMP surface-water reports (Stollar and others, 1990b, 1992). The data and evaluations in these reports are utilized to facilitate the planning of final remediation in the Basin F IRA area and the operation and maintenance of the Basin F IRA structures.

The principle objectives of the groundwater and surface-water elements of the CMP, relative to the Basin F IRA area, are as follows:

- Provide groundwater and surface-water monitoring that specifically supports the operation of the Basin F IRA area and satisfies substantive regulatory requirements.
- Provide data necessary to evaluate the present and project the future hydrologic conditions and migration of contaminants by groundwater and surface-water mechanisms.
- Provide data for design, construction, and operation of the Final Remedial Action.

To achieve these objectives, several technical tasks are anticipated. These tasks include, but may not be limited to, the following:

- Review hydrogeologic data and engineering as-built diagrams of the Basin F area.
- Execute the Basin F IRA area monitoring program utilizing PMRMA sampling and analytical procedures.
- Check and transmit the data following each collection effort. This includes data validation and submission to the U.S. Department of the Army's (Army's) environmental database.
- Assess the data resulting from each collection effort with respect to possible adjustments in the monitoring program during subsequent events.

## 1.2 PURPOSE

The purpose of the groundwater and surface-water monitoring plan is to detail monitoring activities in the Basin F IRA area at RMA as they relate to the CMP. The groundwater monitoring program is presented in Section 2.0, and the surface-water monitoring program is presented in Section 3.0. Information relative to both monitoring programs, including the laboratory monitoring program, maintenance program, health and safety, data management, quality assurance, and reporting and data assessment, is presented in Sections 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, and 9.0, respectively.

## 2.0 GROUNDWATER MONITORING PROGRAM

Groundwater is monitored in the Basin F IRA area as a site-specific component of the CMP. Water quality in the Basin F IRA area is assessed by analyzing groundwater samples collected from alluvial and Denver Formation wells located both upgradient and downgradient of the historic basin perimeter and new structures built as components of the Basin F IRA.

Wells shown in Figure 2.1 are screened within the unconfined flow system or the confined Denver Formation flow system. The unconfined flow system includes saturated alluvium, eolian deposits, and subcropping parts of the Denver Formation where lithologic data indicate the presence of sandstone or relatively permeable material. In areas where alluvial and eolian deposits are unsaturated, the unconfined flow system consists solely of sandstone and fractured or weathered rock within the shallow parts of the Denver Formation. The confined flow system consists of strata within the Denver Formation where water is under greater than atmospheric pressure.

The wells listed in Table 2.1 and shown in Figure 2.1 are sampled annually. A subset of these wells is also sampled quarterly. Wells sampled on a quarterly basis include wells 23049, 23095, 23142, 23220, 23239, 26015, 26017, 26020, 26041, 26073, 26085, 26127, 26160, 26162, 26163, 26164, 26168, 26169, 26170, and 27016. Wells were selected to be in the quarterly water-quality sampling network on the basis of a combination of their location with respect to Basin F IRA structures, frequency of past water quality analyses, and a history of high level contaminant concentrations. Water levels in the unconfined flow system and confined Denver Formation flow system in the Basin F IRA area are measured quarterly utilizing the 246 wells listed in Table 2.2 and shown in Figure 2.2.

Table 2.1: Groundwater Quality Monitoring Network for Basin F IRA Area

<u>Section</u>	<u>Total No. of Wells</u>	<u>Well Designations - Unconfined Alluvial Wells</u>
23	10	049, 095, 142, 179, 188, 191, 220, 237, 239, 241
26	27	015, 017, 019, 020, 041, 071, 073, 083, 085, 127, 133, 148, 157, 158, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 173
27	1	016

Total Alluvial Wells = 38

<u>Section</u>	<u>Total No. of Wells</u>	<u>Well Designations - Confined Denver Formation Wells</u>
23	8	180, 181, 189, 190, 192, 193, 221, 222
26	15	066, 067, 072, 075, 084, 086, 129, 140, 142, 146, 149, 150, 153, 155, 156

Total Denver Wells = 23

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IRA = Interim Response Action  
No. = number

20006,110.10 - CWMP  
1119060392

Table 2.2: Quarterly Water-level Monitoring Network for Basin F IRA Area

Section	Well Designations - Unconfined Alluvial Wells
23	002, 004, 007, 010, 011, 013, 016, 029, 030, 036, 039, 040, 045, 046, 049, 057, 059, 072, 079, 084, 085, 092, 094, 095, 102, 108, 110, 118, 119, 120, 121, 123, 134, 135, 140, 142, 146, 150, 157, 160, 166, 178, 179, 188, 191, 196, 197, 198, 205, 207, 208, 211, 220, 223, 231, 232, 237, 238, 239, 241
26	006, 010, 015, 016, 017, 019, 020, 040, 046, 048, 049, 050, 062, 065, 068, 073, 076, 081, 083, 085, 088, 091, 093, 124, 127, 133, 143, 145, 148, 157, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 173
27	002, 003, 004, 005, 006, 007, 009, 010, 011, 016, 018, 025, 031, 037, 040, 041, 042, 043, 044, 045, 051, 053, 062, 063, 064, 066, 068, 070, 071, 072, 074, 075, 077, 080, 081, 082, 083, 085, 086

Total Alluvial Wells = 142

Section	Well Designations - Confined Denver Formation Wells
23	053, 055, 106, 125, 144, 161, 176, 177, 180, 181, 182, 183, 184, 185, 186, 187, 189, 190, 192, 193, 199, 200, 201, 202, 203, 204, 209, 218, 219, 221, 222, 224, 225, 226, 227, 228, 229, 230, 233, 234, 235, 236
26	023, 024, 025, 026, 027, 028, 029, 041, 047, 051, 055, 056, 057, 058, 060, 061, 063, 064, 066, 067, 069, 072, 074, 075, 077, 079, 080, 082, 084, 086, 089, 090, 092, 094, 096, 097, 123, 128, 129, 130, 134, 135, 136, 140, 141, 142, 144, 146, 147, 149, 150, 151, 152, 153, 155, 156
27	049, 054, 055, 057, 058, 084

Total Denver Formation Wells = 104

IRA = Interim Response Action

BURLINGTON DITCH

BURLINGTON NORTHERN

22

2

C STREET

NORTHWEST BOUNDARY  
CONTAINMENT SYSTEM

TEMPORARY  
STORAGE PONDS

27

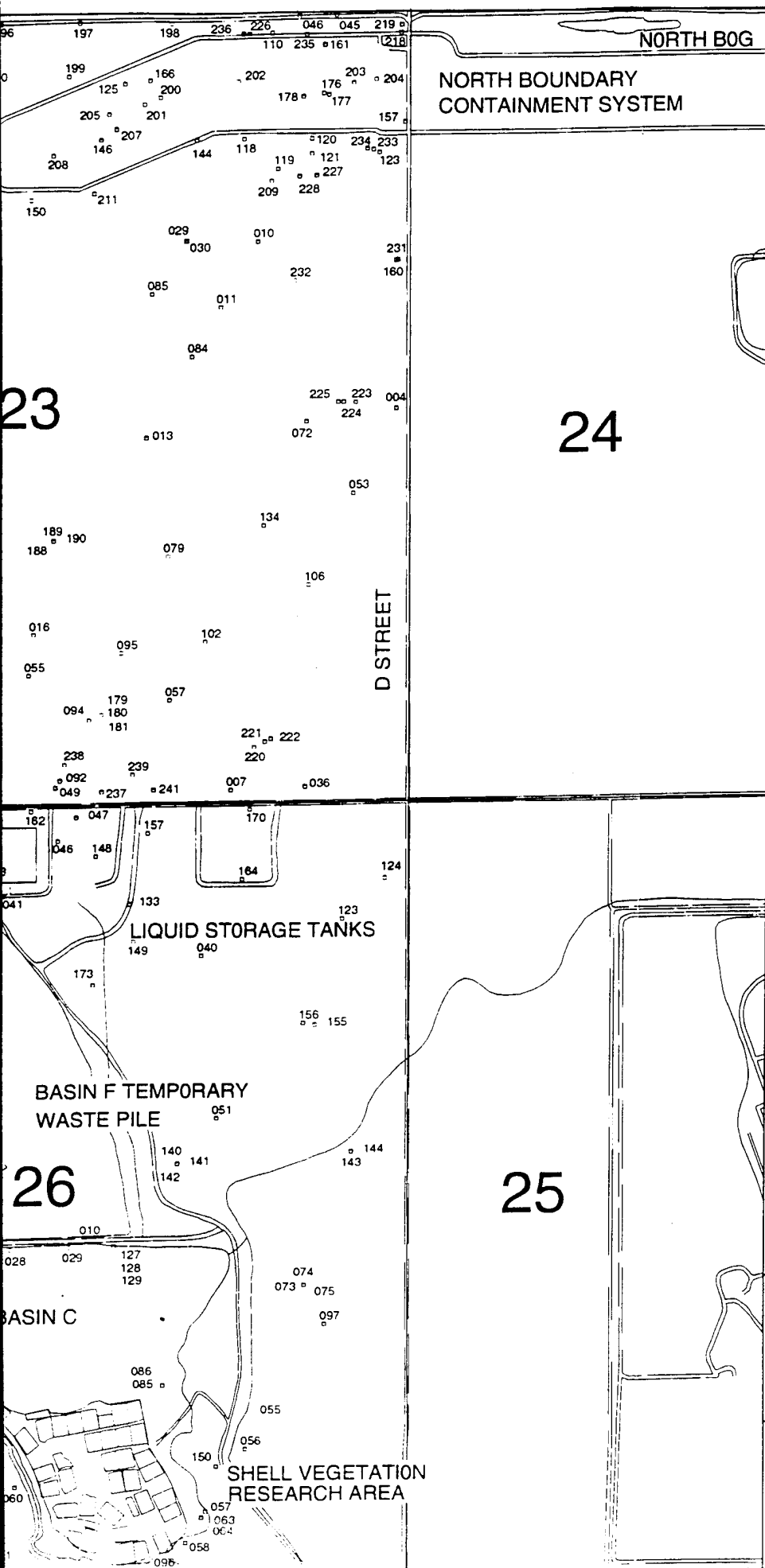
FORMER  
BASIN F

BASIN E

BASIN D

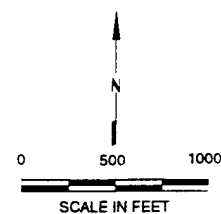
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## EXPLANATION

WELL LOCATION USED FOR  
WATER LEVEL MEASUREMENT



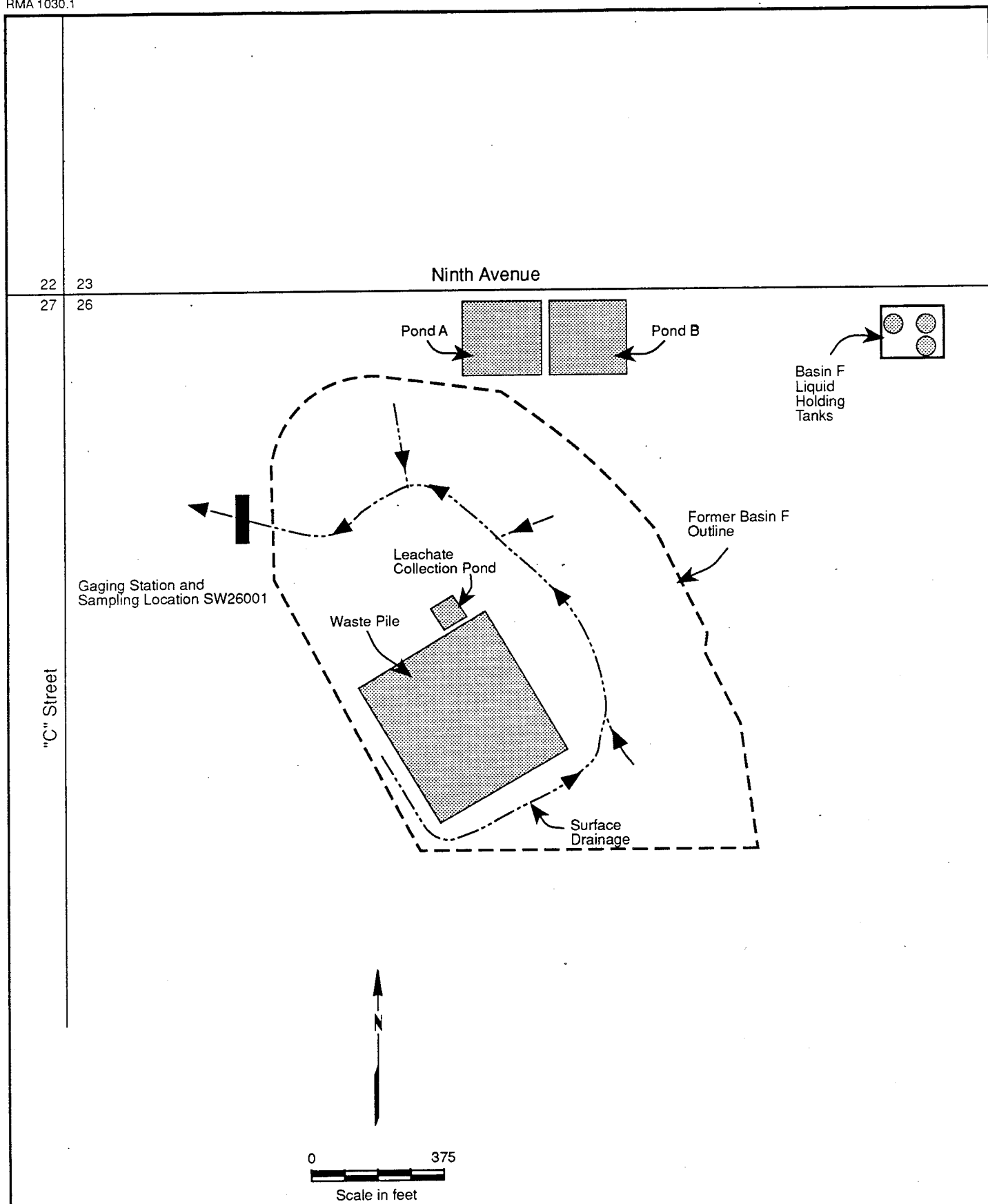
Prepared for:  
Program Manager for  
Rocky Mountain Arsenal

Figure 2.2  
Water-Level Monitoring Well  
Locations for Basin F IRA Area

### 3.0 SURFACE-WATER MONITORING PROGRAM

Water quality of surface water in the Basin F IRA area will be assessed by analyzing samples collected at the gaging station shown in Figure 3.1. The frequency of sampling will depend on the availability of surface-water runoff. Runoff is expected only during high precipitation events or during significant snow melt. Four sampling events are expected per year. Water quantity will be monitored on a continuous basis utilizing an electronic monitoring device with a Parshall flume and stilling well (Rantz and others, 1982).





Prepared for:  
Program Manager for  
Rocky Mountain Arsenal  
Commerce City, Colorado

Figure 3.1  
BASIN F GAGING STATION

#### 4.0 LABORATORY ANALYTICAL PROGRAM

Groundwater and surface-water samples collected from the Basin F IRA area will be analyzed for parameters listed in Table 4.1. This list may be modified for future sampling events on the basis of remedial investigation/feasibility study and CMP data interpretation, and on the basis of evaluation of the gas chromatography/mass spectroscopy (GC/MS) analysis of nontarget analytes. Any revisions to the analytical program will be incorporated into a revised work plan.

In addition to the quantitative analytical results obtained for target analyte list parameters, the laboratory analytical program will include a semiquantitative GC/MS analysis of randomly selected groundwater and surface-water samples. The GC/MS technique will be used to confirm those target analytes that can be detected by gas chromatography (GC) and indicate the presence of nontarget analytes. Consistent with prior practice, where nontarget analytes are repeatedly detected at elevated levels, action will be taken to identify the major compounds and evaluate them for incorporation into the target analyte list.

GC/MS analysis will be performed on approximately 10 percent of the groundwater and surface-water samples collected.

Table 4.1: Target Analyte List for Groundwater  
and Surface-Water Sampling in the Basin F IRA Area  
(Page 1 of 2)

ANALYSIS/METHODS/ANALYTES

Agent Products/HPLC

Thiodiglycol

Agent Products/IONCHROM

Isopropylmethylphosphonic acid

Metals/ICP

Cadmium  
Chromium  
Copper  
Lead  
Zinc

Organophosphorus Compounds/GCFPD

Diisopropylmethylphosphonate (DIMP)  
Dimethylmethylphosphonate (DIMP)

Semivolatile Organic Compounds/GCMS

1,4-oxathiane  
2,2'-bis(Para-chlorophenyl)-  
1,1-dichloroethane  
2,2'-bis(Para-chlorophenyl)-  
1,1,1-trichloroethane  
Aldrin  
Atrazine  
Chlordane  
Chlorophenylmethyl sulfide  
Chlorophenylmethyl sulfone  
Chlorophenylmethyl sulfoxide  
Dibromochloropropane  
Dicyclopentadiene  
Dieldrin  
Diisopropylmethyl phosphonate  
Dimethylmethyl phosphonate  
Dithiane  
Endrin  
Hexachlorocyclopentadiene  
Isodrin  
Malathion  
Parathion  
Supona  
Vapona

Organochlorine Pesticides/GCECD

2,2'-bis(Para-chlorophenyl)-  
1,1-dichloroethane  
2,2'-bis(Para-chlorophenyl)-  
1,1,1-trichloroethane  
Aldrin  
Dieldrin  
Endrin  
Hexachlorocyclopentadiene  
Isodrin

Organophosphorus Pesticides/GCNPDP

Atrazine  
Malathion  
Parathion  
Supona  
Vapona

Organosulphur Compounds/GCFPD

1,4-Oxathiane  
Benzothiazole  
p-Chlorophenylmethyl sulfide  
p-Chlorophenylmethyl sulfone  
p-Chlorophenylmethyl sulfoxide  
Dimethyldisulfide  
Dithiane

Volatile Aromatic Organic  
Compounds/GCPID

Benzene  
Ethylbenzene  
m-Xylene  
o- and p-Xylene  
Toluene

Volatile Halogenated Organic  
Compounds/GCCON

1,1-Dichloroethane  
1,2-Dichloroethane  
1,1-Dichloroethylene  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Carbon tetrachloride

Table 4.1: Target Analyte List for Groundwater  
and Surface-Water Sampling in the Basin F IRA Area  
(Page 2 of 2)

Volatile Halogenated Organic  
Compounds/GCCON (continued)

Chlorobenzene  
Chloroform  
Methylene chloride  
Tetrachloroethylene  
Trans-1,2-dichloroethylene  
Trichloroethylene

Volatile Hydrocarbon Compounds/GCFID

Bicycloheptadiene  
Dicyclopentadiene (DCPD)  
Methylisobutyl Ketone (MIBK)

Arsenic/AA

Dibromochloropropane/GCECD

Mercury/AA

Cyanide/Colorimetric

Anions/Ionchrom

Chloride  
Fluoride  
Sulfate

Cations/ICP

Calcium  
Magnesium  
Sodium  
Potassium

Volatile Organic Compounds/GCMS

1,1-Dichloroethane  
1,2-Dichloroethane  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Benzene  
Bicycloheptadiene  
Carbon tetrachloride  
Chlorobenzene  
Chloroform  
Dibromochloropropane  
Dicyclopentadiene  
Dimethyldisulfide  
Ethylbenzene  
m-Xylene  
Methylene chloride  
Methylisobutyl ketone  
o- and p-Xylene  
Tetrachloroethylene  
Toluene  
Trans-1,2-dichloroethylene  
Trichloroethylene

Alkalinity

Conductivity

pH

Nitrate/Nitrite/Colorimetric

AA = Atomic Absorption Spectroscopy  
GCCON = Gas Chromatography/Conductivity Detector  
GCECD = Gas Chromatography/Electron Capture Detector  
GCFID = Gas Chromatography/Flame Ionization Detector  
GCFPD = Gas Chromatography/Flame Photometric Detector  
GCMS = Gas Chromatography/Mass Spectrometry  
GCNPD = Gas Chromatography/Nitrogen Phosphorous Detector  
GCPID = Gas Chromatography/Photoionization Detector  
HPLC = High Performance Liquid Chromatography  
ICP = Inductively Coupled Argon Plasma Screen  
IONCHROM = Ion Chromatography

## 5.0 MAINTENANCE PROGRAM

The maintenance program for the Basin F IRA area water monitoring activities will consist of maintaining existing monitoring wells and gaging stations. The maintenance program also includes replacement of existing wells that have been destroyed and installing new monitoring wells or gaging stations if required. Any new wells would be installed following guidelines required by PMRMA (U.S. Army Toxic and Hazardous Materials Agency [USATHAMA], 1987).

The need for maintenance activities will be evaluated after each water-level monitoring and water-quality sampling event. Maintenance problems identified will be corrected before the next sampling event. If monitoring well maintenance is required, it will be limited to the following maintenance activities:

- Repair of casing stickups
- Installation of protector casings
- Installation of steel marker posts
- Installation and/or repair of surface seals
- Resurvey of repaired well sites
- Installation of permanent identification tags
- Installation of replacement well caps
- Clearance of weeds from the area around the wells
- Installation of weed barrier mats
- Redevelopment of monitoring wells
- Removal of accumulated sediment in well casing

Maintenance of the surface-water gaging station will include the following:

- Weekly inspection
- Resurvey of any repaired installations
- Installation of permanent identification tags
- Clearance of weeds from the area around the gaging station

- Removal of accumulated channel debris
- Removal of sediment or debris in the stilling well and intake pipes

## 6.0 HEALTH AND SAFETY

The health and safety procedures followed by the site investigation teams during sampling activities at the Basin F IRA area are described in the CMP Health and Safety Plan (Stollar and others, 1988a) or health and safety plans that will be developed and identified by PMRMA as components of future PMRMA water monitoring programs.

## 7.0 DATA MANAGEMENT

The CMP Data Management Plan (Stollar and others, 1988b) outlines the general procedures to be utilized for the Basin F IRA area. Data collected and analyzed from the Basin F IRA area will be added to the overall PMRMA database. The Data Management Plan will be revised, if needed, as a component of future PMRMA water monitoring programs.



## 8.0 QUALITY ASSURANCE

The quality assurance procedures to be followed for the Basin F IRA area water monitoring activities are described in the CMP Project Quality Assurance Plan (Stollar and others, 1988c) and are in accordance with current PMRMA requirements. This plan includes project quality assurance/quality control (QA/QC) organization and responsibilities, approach to QA, laboratory certification, sampling, sample preparation, materials shipping and handling, chain-of-custody procedures, analysis, system control, instrument maintenance, recordkeeping, audits, corrective actions, and QC reports. The CMP Project QA Plan will be revised, if needed, as a component of future PMRMA water monitoring programs.

## 9.0 REPORTING AND DATA ASSESSMENT

Data collected in the Basin F IRA area from October 1991 through September 1992 will be assessed and reported in the Groundwater Monitoring Program 1992 annual report. The Groundwater Monitoring Program succeeds the CMP. The Basin F IRA area will be treated as a site-specific area; work products will describe hydraulic conditions and contaminant flow. Specific work products may include the following:

- Water-level contour maps
- Contaminant distribution or plume maps, where possible, for each analyte or for analyte groups
- Revised geologic maps based on additional geologic data
- Maps indicating any revisions in areas of unsaturated alluvium and the extent of inferred paleochannels, if necessary

The accompanying text for the work products listed above will include a hydrogeologic analysis and a contamination assessment to describe the rate of migration and extent of contamination in groundwater and surface water in the Basin F IRA area.

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